Quality Control System of Crude Palm Oil on Palm Oil Processing Industry (Case Study Bah Jambi Palm Oil Mill, PTPN IV, Medan, North Sumatra)

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Abstract- Bah Jambi POM (Palm Oil Mill) encounters several obstacles in order to meet the quality standard of its main products, namely CPO (Crude Palm Oil). Quality standard of CPO produced, such as levels of FFA (Free Fatty Acid), often exceed the quality standards set by the customer even though the company has implemented a quality control system. The purpose of this study are (1) analyse the effectiveness of the implementation of quality control management in Bah Jambi POM to achieve quality standards of CPO set by the customer (2) to identify the factors that affect the quality of CPO in the value chain of palm oil processing industry in Bah Jambi POM. The analytical method used are statistical process control (SPC) and the causal diagram (fishbone). Results show that the quality control of FFA levels is not effective yet and have not been able to meet the quality standards specified by the customer preferences of 4.5%. The value of the FFA levels process capability are 1.282, which means the state of the industry is in a stable state and cannot afford, meaning that the process is in a state of not being able to afford enough to produce the products according to the needs and expectations of customers. Through analysis of the causal diagram showed that the factors that cause the quality of FFA levels above the quality standards set by the customer are machine, man, management, materials and methods. The improvement strategy and quality control of the CPO that can be used as inputs for the company are management companies need to conduct periodic engine maintenance and training for employees is continuous.

Index Terms- Quality Control, FFA levels, SPC, Statistical Process Control

I. INTRODUCTION

Oil palm plantations now spread to almost all regions in Indonesia. Growth of acreage, production and productivity of palm oil from year to year continued to show a rising trend. In 2014, the acreage of palm oil grew by 4.69% from the previous year, while for the production and productivity grew by 5.62% and 0.90%.

Palm oil processing industry cannot be separated from fresh fruit bunches (FFB) as a raw material, Crude Palm Oil (CPO) and Palm Kernel Oil (PKO) as processed products. CPO quality is highly dependent on FFB coming into the mill. The mill cannot produce good quality of oil without any good raw materials. To obtain a good end quality product, it needed a good quality control.

CPO is composed of a solid fraction which is a saturated fatty acid (myristic 1%; palmitic 45%; stearate 4%) and liquid fractions are unsaturated fatty acids (oleic 39%; linoleic 11%). Indonesia's CPO has low quality because almost 90% do not contain β-carotene ($C_{40}H_{56}$ Molecular Weight: 536.85) which is soluble in oil and causing a yellow/orange. The physical properties of CPO are orange's color, distinctive odor, paste, water content: $3,7589 \times 10^{-3}$ mL/g CPO, the refractive index of 1.4692, a density of 0.8948 g/mL solubility in ether and quite soluble in acetone, slightly soluble in ethanol and insoluble in water brackish (Setyono and Soetarto, 2008).

Quality control is a tactic and strategy of the company in the global competition with other companies' products. Quality is a basic factor in the decision of choosing a product. When consumers feel a certain product is much better quality than competitor products, then the consumer decides to buy the product. The ever-changing consumer demands is what needs to be responded by the companies. Therefore, companies must implement a quality control in the manufacture of products. Product quality will affect the level of customer satisfaction and corporate profits. Quality will give a huge impact in the marketing and product sales rate, because quality is one thing that is important to get special attention by a company.

Perkebunan Nusantara IV Limited Company (PTPN IV) is a State-Owned Enterprises (SOEs) which is engaged in the agro-industry. PTPN IV cultivate cultivation, processing and sales of palm oil products and derivatives following the tea gardens with a total area of ± 175 thousand hectares spread over several areas in North Sumatra.

Bah Jambi Palm Oil Mill (POM) is one of POM owned by PTPN IV with the largest capacity that are 60 tons. Bah Jambi POM began operations in 1967 with an initial capacity of 30 tons of FFB per hour, which was increased in 1972 to 50 tons of FFB per hour. In 1998 implemented revamping the layout, spatial and improvement of POM machinery capacity of 50 tons of FFB per hour to 60 tons of FFB per hour. Bah Jambi POM process oil palm fruits into CPO which is a semi-finished material, then sent to the PT. SAN Belawan.

Bah Jambi POM (Palm Oil Mill) encounters several obstacles in order to meet the quality standard of its main products, namely CPO (Crude Palm Oil). Quality standard of CPO produced, such as levels of FFA (Free Fatty Acid), often exceed the quality standards set by the customer even though the

company has implemented a quality control system. It is what lies behind the importance of an effective and efficient quality control system so that companies can reduce production costs and increase revenue for the industry.

The purpose of this study are (1) analyse the effectiveness of the implementation of quality control management in Bah Jambi POM to achieve quality standards CPO used by customer (2) to identify factors that affect the quality of CPO in the value chain of palm oil processing industry at Bah Jambi POM.

II. RESEARCH ELABORATIONS

The study was conducted at Bah Jambi Palm Oil Mill (POM), Perkebunan Nusantara IV Limited Company (PTPN IV) located in the district of Java Maraja Bah Jambi and Tanah Jawa, Simalungun, North Sumatra Province. This research was conducted in April to May 2015.

The types and sources of data used in this study are primary data and secondary data. The primary data obtained through direct observation and interviews, while secondary data obtained from the company's internal data. The type and source of research data can be seen in Table 1.

Table 1. Data Types and Sources of Research

Data types	Data source

Primary data:
  1. Results of direct observation and interviews regarding:
    a. CPO production and levels of ALB, water and dirt.
    b. Deviations quality CPO.
	Respondents internal (suppliers, production division, laboratory division etc.)

Secondary Data:
  1. Data of FFB supplier.
  2. Data of FFB quality at the reception.
  3. Data of FFA measurement, moisture content and impurity content.
	The company's internal data.

Methods of data analysis used in this study is a statistical process control (Statistical Process Control / SPC) and the causal diagram (fishbone). According Dervitsiotis (1981), is a process control procedures designed to identify any error process significant production from several natural range of variation of the critical process or product characteristics. The presence of non-random variations associated with specific causes and generally ask management to take corrective measures to make the process under control.

ALB levels of quality control analysis using statistical process control (Statistical Process Control / SPC) which is integrated with the concept of Six Sigma analysis (Gasperz, 2001), while the data processing is done using Microsoft Office Excel 2007 and IBM SPSS Statistics 23.

Causal diagram is used to identify the factors that cause the problem. This diagram presents a complete issue to state the relationship between the problem due to the causes (Haslindah, 2013). Analysis of the data record keeping so that it will get an overview of the process that do not running and the condition of the company so it is necessary to identify the factors that cause

these conditions or problems that occur in the process or system. The problem identification is done by making a causal diagram (fishbone diagram) by focusing on the causal factors that often occur such as a machine, man, method, materials and management.

Bah Jambi POM encounters several obstacles in order to meet product quality standards of CPO. CPO produced by PTPN IV still not consistent and often are under the defined quality standards. That is because the quality management system implemented has not been effective and should be immediately carried out a corrective action to address such deviations. In order for the quality management system can be run effectively and efficiently, it is necessary to do a thorough study of palm oil products quality control in accordance with the objectives and strategies that have been implemented by PTPN IV. The method can be used one of them is the concept of six sigma by using tools such as Statistical Process Control (SPC), after the identification of the factors that cause the problem by using a fishbone chart. The framework of the research described in Figure 1.
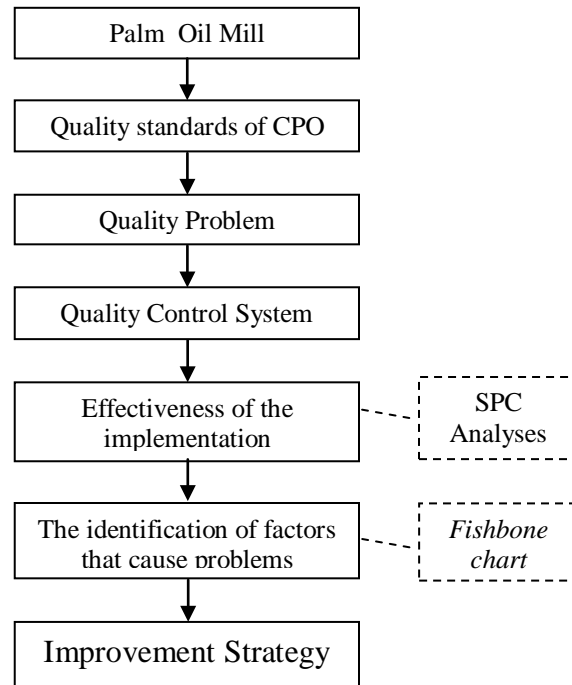
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│  Quality standards of CPO │
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│      Quality Problem    │
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│   Effectiveness of the  │ ─ ─ ─ │    SPC    │
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│   Improvement Strategy  │
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Figure 1 The framework research

III.   RESULTS AND FINDINGS

Quality Control Analysis of FFA levels

Product quality that produced by Bah Jambi POM, analyzed by Statistical Process Control to determine the condition of CPO quality in achieving quality standards set by customer. Descriptive statistics measuring the quality of CPO from April to May 2015 may be seen in Table 2.

Table 2. Descriptive Statistics measuring the quality of CPO from April to May, 2015

Descriptive Statistics	% kadar ALB
Mean (X-bar)	3,4833
Standar Deviation (S)	0,48574
Sample Variance	0,236
Minimum	2,80
Maximum	4,53
Count	54
Upper Spesific Limit – USL	4,5
Target	3
Upper Control Limit – UCL	4,3122
Process Capability	1,282
Sigma Level	2,55

The results of data processing quality of FFA levels during April - May 2015, gained control of the limit value Upper Control Limit (UCL) amounted to 4.31%. UCL value is used as the control limits so that the process does not pass the quality standards set or a specific upper limit (USL). Control Chart% ALB levels can be seen in Figure 2.

Process Statistics

Capability Indices	CP[a]	1,282

The normal distribution is assumed. LSL = 2 and USL = 4,5.

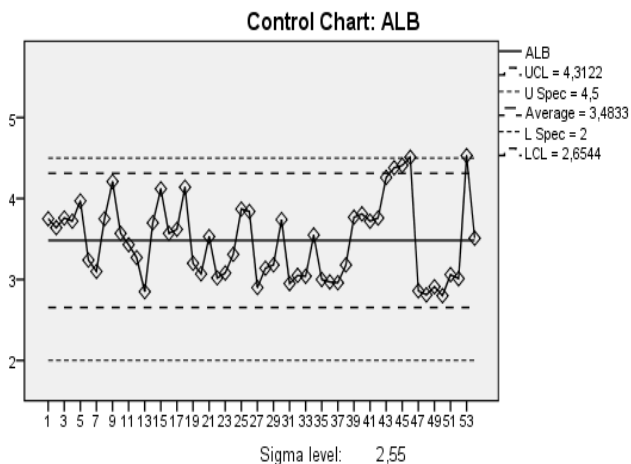a. The estimated capability sigma is based on the mean of the sample moving ranges.

Figure 2. Control Chart % FFA levels.

In figure 2 it can be seen that most of the FFA levels quality of Bah Jambi CPO is above the target line, the quality standards set by the company. Accounted for two samples which exceed the USL line, which means that the CPO product on the sample being measured, cannot meet the quality standards specified by customer.

CPO production process capability in order to deliver quality ALB levels corresponding to predetermined measurable using process capability analysis. Based on the analysis results obtained CPA value of 1.282, which means the state of the industry is in a stable state and cannot afford, meaning that the process is in a state of not being able to afford enough to produce the products according to the needs and expectations of customers.

The CP value is low because the value of DPMO (defects per million opportunities) amounted to 146.900, which means that in a million occasions CPO production Bah Jambi POM likely will experience failure of production as much as 146.900 times in order to achieve the quality standard levels of FFA set by customer. Under these conditions, the sigma value obtained for the 2.55-sigma, very far from the maximum sigma value that is equal to 6-sigma. As a manufacturer of biological products, the level of achievement is said to be quite low due to biological products, the average sigma is at 3-sigma level.

The identification of Factors that Cause Problems

Based on the analysis of quality control for the quality levels of FFA, note that Bah Jambi POM has a constraint in achieving the quality standards FFA levels. Therefore, the need for further analysis using charts "causal diagram" in order to know the cause of the anomaly (Muktiadji, 2006). Causal diagram is shown in Figure 3.

Figure 3. Causal diagram
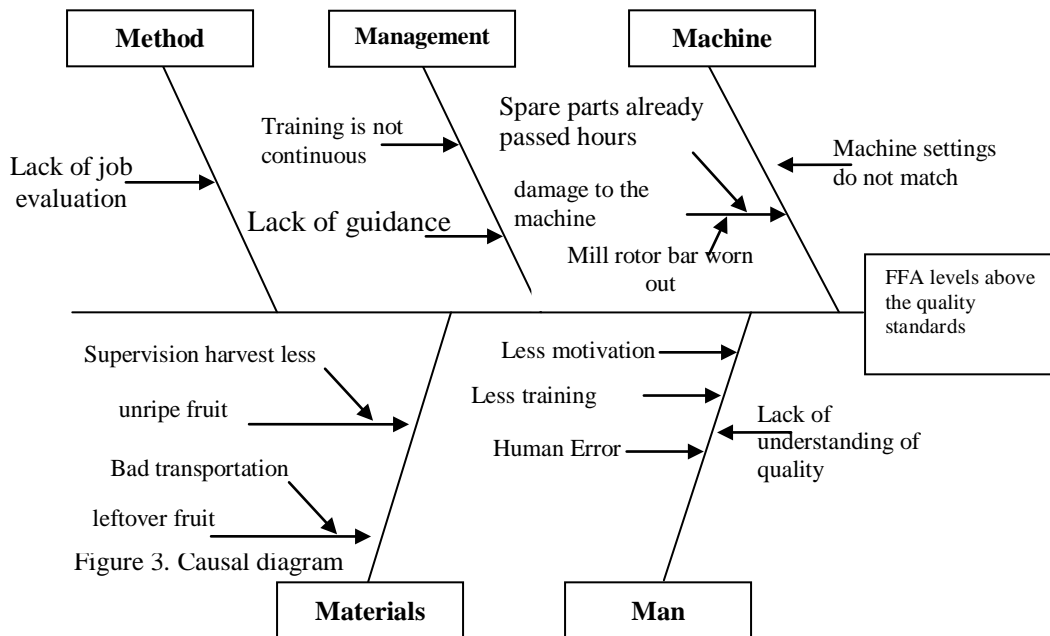
1. Machine

High FFA levels of CPO can be affected by the condition of the main engines at Bah Jambi POM. Damage to the machine is very disturbing the smooth processing of palm oil. Damage to the machine at Bah Jambi POM often occurs because the mill rotor bar worn out and spare part is already past work hour. When the machine is damaged, it will terminate the entire processing cycle, consequently the fruit had to wait to be processed so that it will increase the value of FFA levels in the fruit. Settings that do not fit the standard machine can also increase the value of ALB levels in the fruit.

2. Management

Management's commitment to supporting facilities and infrastructure, in order to achieve the quality standards set by the

customer is very important (Novanda, 2011). This can be demonstrated by providing training to employees is continuous and also provide guidance and direction to employees at work so that employees understand the importance of understanding the quality.

3. Man

High levels of FFA can also be influenced by human resources itself. Human errors such as when the machine setup can cause the resulting product does not comply with the request or customer. Discipline and accuracy is very important to be owned by the employees of the laboratory to test the levels of free fatty acids (Wulan, 2014). Factors not motivated to work better, lack of control in the process of work and lack of performance assessments, resulting in factory employees and gardens are less concerned about the work that they are responsible. Besides the lack of training of human resources also causes lack of understanding about the importance of product quality.

4. Material

High levels of FFA can be caused by several things, one of which is the quality of the raw material (FFB) which is not in accordance with defined quality standards. The number of CPO with ALB levels above USL, because there are still harvested fruit is not transported to the plant on the day of harvest (remainder). The high number of TBS that leftover that can cause product degradation. The condition (remainder), caused by several factors, namely transport TBS from the garden to the plant is not smooth.

In addition, the FFB harvested also often still raw. Poor harvests supervision caused FFB is still raw join thus reducing the company's production.

5. Method

Based on observations and interviews, the lack of a routine evaluation of the work done cause the quality of the resulting standards are often not in accordance with customer demand. For the method performed at the factory, it will also affect the quality of the resulting company, especially good processing with the aim to meet customer demand.

IV. IMPROVEMENT STRATEGY

Based on the factors that cause high levels of FFA at Bah Jambi POM, must be immediately initiated corrective actions in order to maintain its product quality of CPO. Strategy improvement and quality control in accordance with the order of priority starting from the aspect of the machine, man, management, materials and methods. Prioritization of strategy adapted to the results of the field observations and interviews with relevant parties.

1. Machine

Machinery is a top priority because the spare part is already past the hour road so it must be repair and replacement of damaged machinery and older. Mill rotor bas worn should be replaced with new ones and machine settings must be in accordance with the SOP.

2. Man

Human resources must have a good understanding of the quality, it is necessary for employee training is continuous. Improving accuracy to reduce human error and also provide motivation to employees to keep the spirit to work.

3. Management

Policy management becomes a basic implementation of quality control at Bah Jambi POM. Management must be committed to support all efforts by providing guidance and direction to the employees to achieve quality standards of CPO. Management must also provide facilities and supporting infrastructure to realize the targets set.

4. Material

It takes a good harvest supervision order did not participate harvested unripe fruit. In addition, repair and transportation facilities eg damaged roads and also repair and perform maintenance on vehicles operated so that the fruit can get to the mill on the same day and did not experience any leftover.

5. Method

It takes a performance evaluation that is supported by a repair system that can synergize four aspects mentioned earlier to support all activities aimed to produce the desired CPO.

V. CONCLUSIONS

Based on the analysis of quality control CPO, concluded that the FFA levels at Bah Jambi POM is not yet effective and have not been able to meet the quality standards specified levels of ALB buyers / customers of 4.5%.

Based on the analysis results obtained CP value of 1.282, which means the state of the industry is in a stable state and can not afford, meaning that the process is in a state of not being able to afford enough to produce the products according to the needs and expectations of customers.

The results of the analysis of the causal diagram shows that the factors that lead to high quality levels of FFA, above the quality standards set by the customer is machine, man, management, materials and methods.

Suggestion
1. Management companies need to conduct periodic engine maintenance and training for employees is continuous.
2. The company need to do a cost analysis to determine the costs that must be invested to implement corrective actions in order to maintain and improve the quality and also implement an integrated quality management system so that the investment made more effective and efficient.

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